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(56) Documents Cited
 US 4757222 A US 4728833 A
 PAJ abstract and JP62147941 (Matsushita)
 PAJ abstract and JP60113646 (Takahashi)
 PAJ abstract and JP2214455 (Shicoh)

(58) Field of Search
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(54) Abstract Title
Structure for an easy-to-start DC brushless motor

(57) A structure for an easy-to-start dc brushless motor includes a base 1, plural windings 13, an integrated circuit control means 14 mounted on the base, and a rotor 2. The control means 14 includes a conventional drive circuit and a Hall element. At least one magnetically attractive positioning member 17 is mounted to the base and located between two windings 13 that are adjacent to each other. The rotor 2 includes a permanent magnet ring 22 having north and south poles, each pole having a strong magnetic area 222. When the rotor 2 stops, the positioning member 17 attracts and retains one of the strong magnetic areas 222 in a position proximal to the positioning member. Thus, the rotor rests in a predetermined position not located in a dead spot; the single control means 14 can then reliably detect the polarities of the magnetic ring 22 and thus easily and reliably restart the motor.

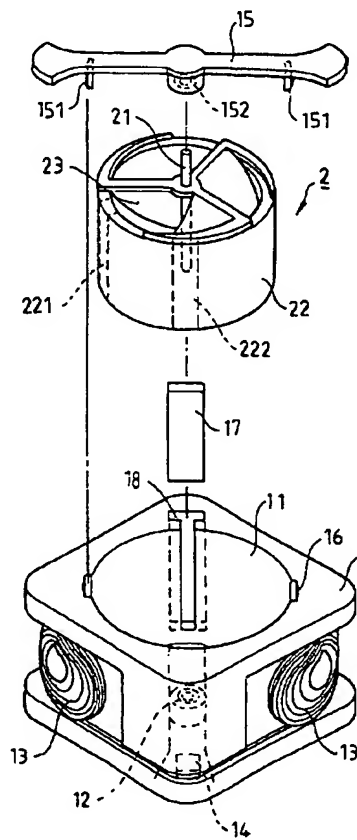


FIG. 1

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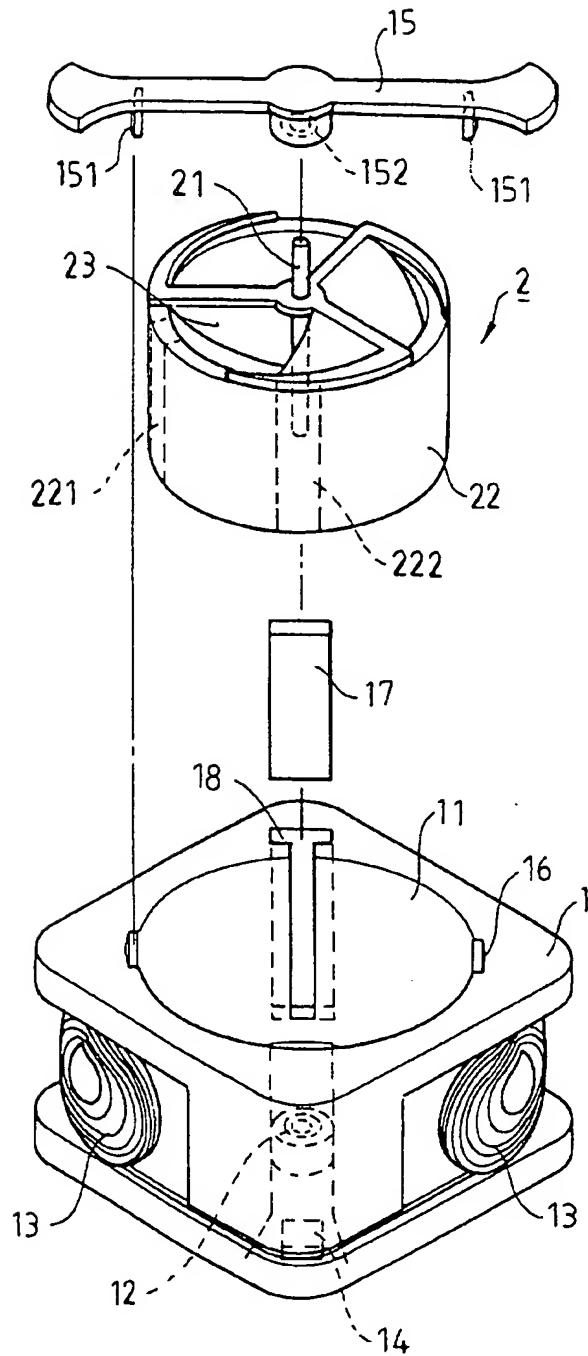


FIG. 1

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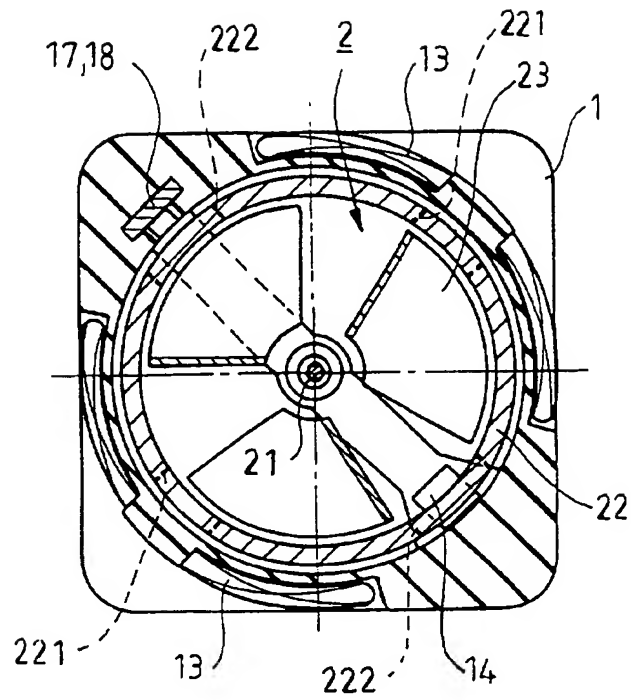


FIG. 2

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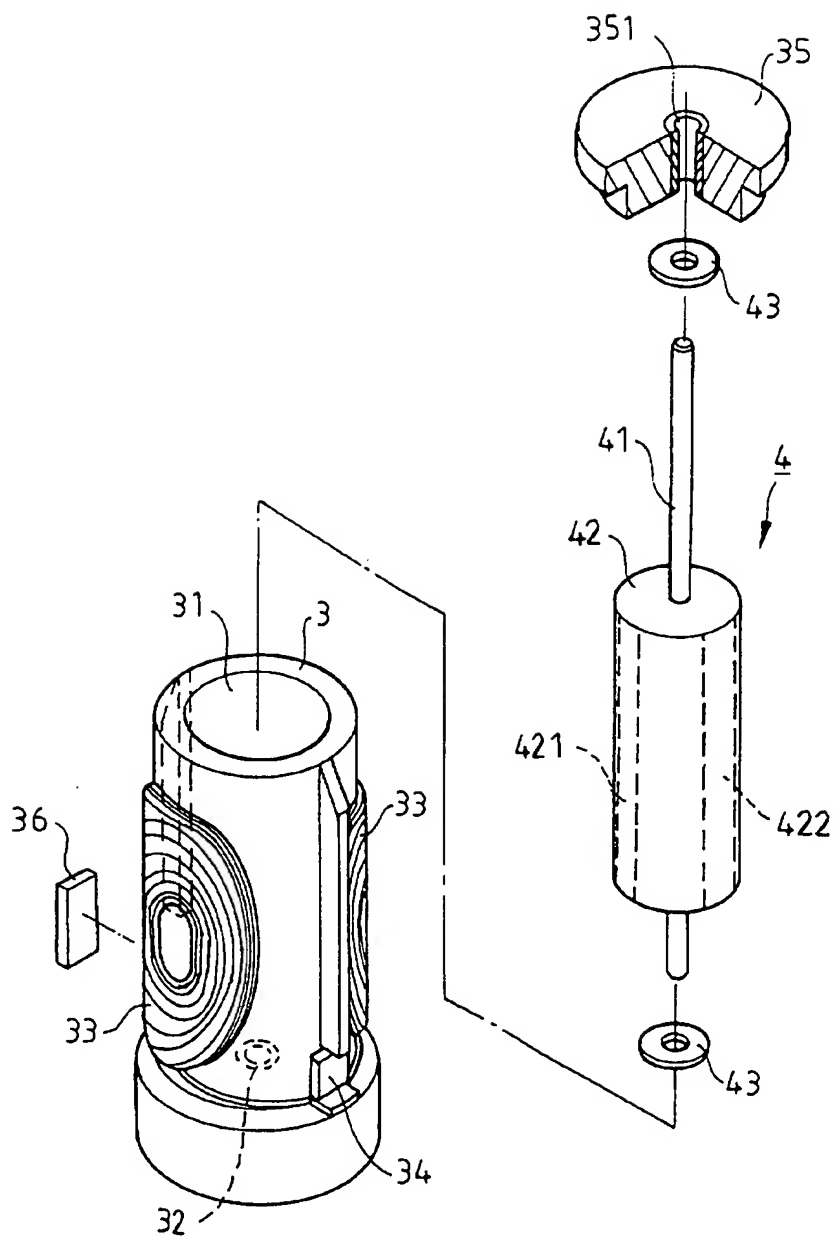


FIG. 3



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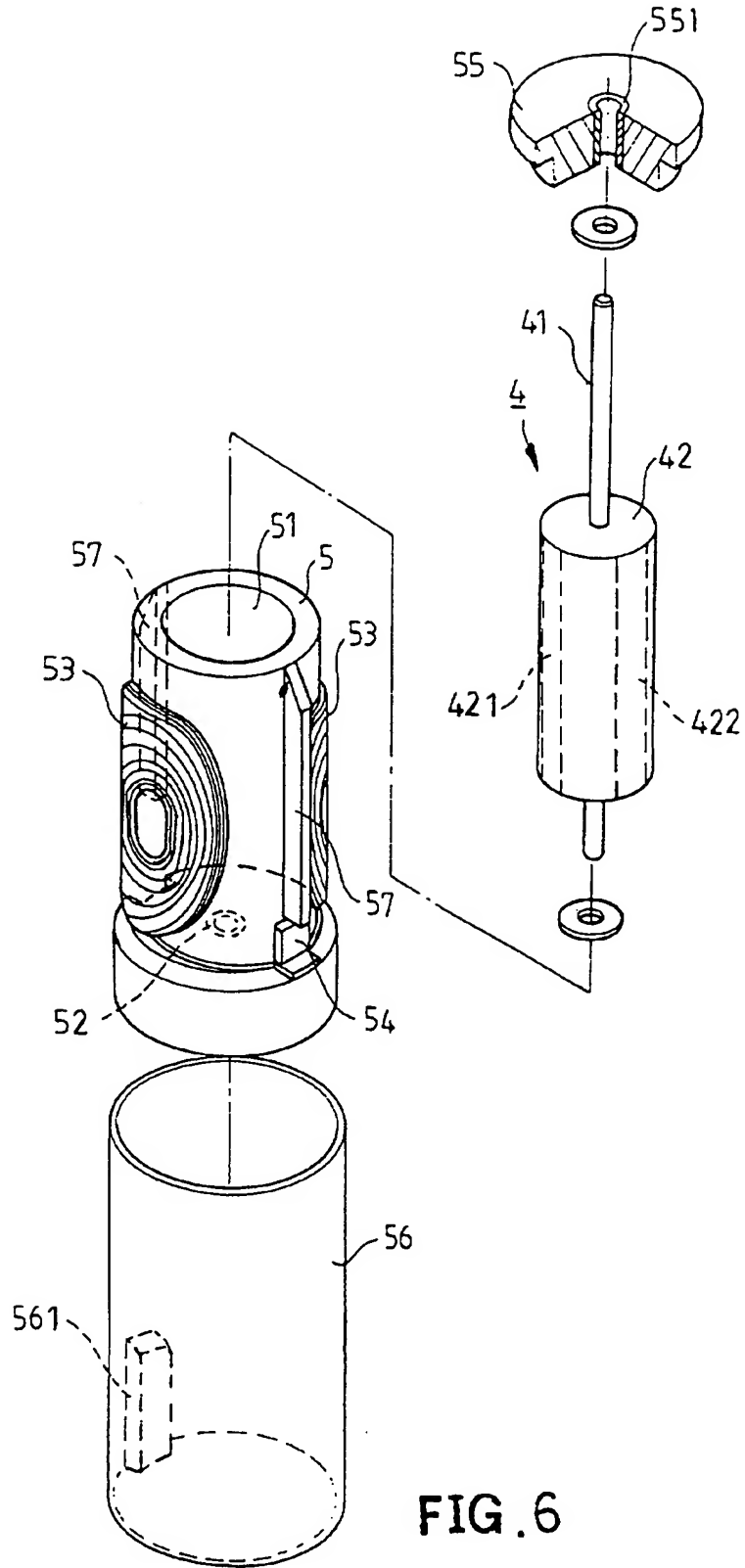


FIG. 6

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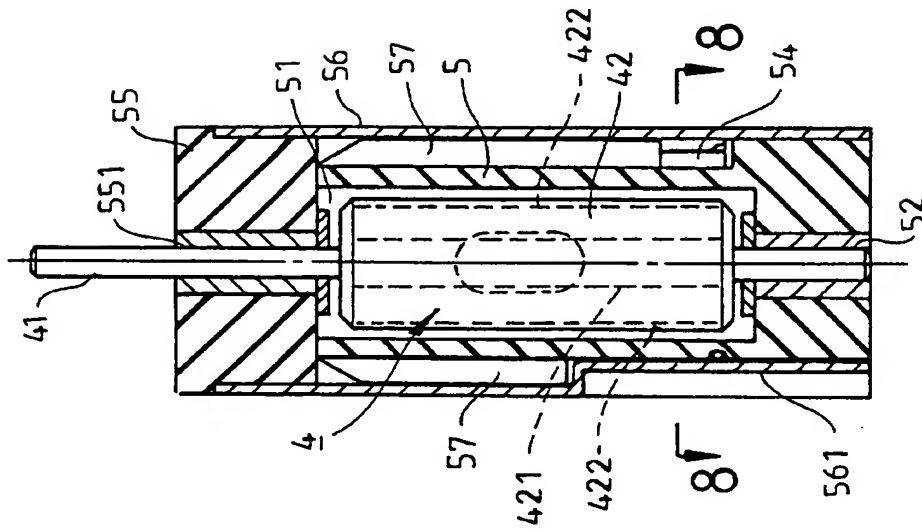


FIG. 7

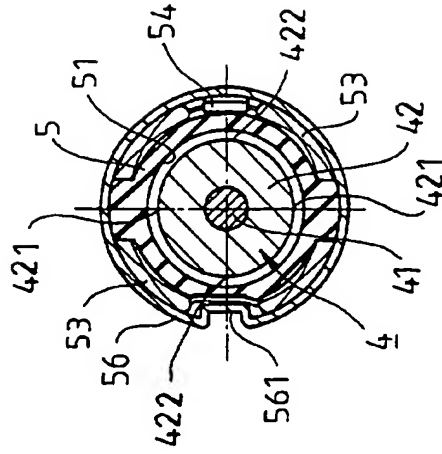


FIG. 8

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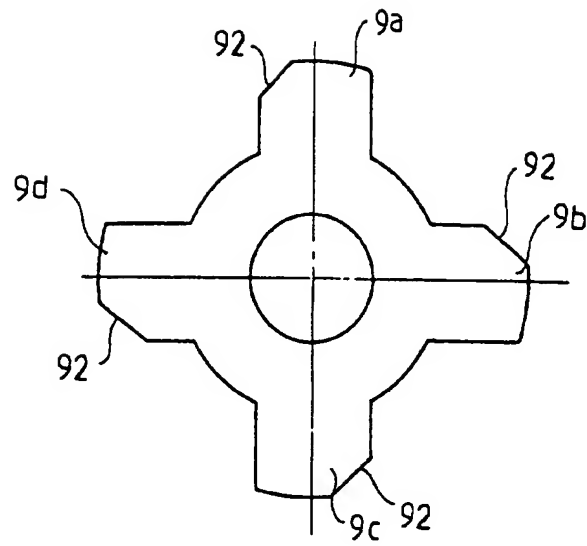


FIG. 9
PRIOR ART

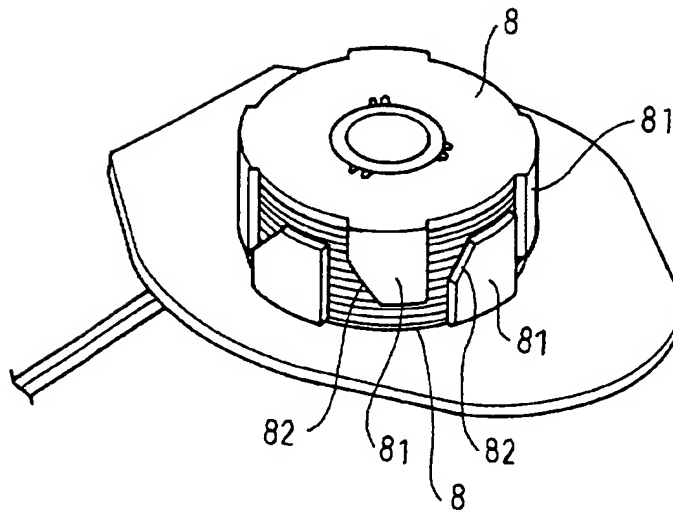


FIG. 10
PRIOR ART

EASY-TO-START STRUCTURE OF A DC BRUSHLESS MOTOR**Background of the Invention****1. Field of the Invention**

The present invention relates to an easy-to-start structure of a DC brushless motor in which the rotor of the motor may rest in an easy-to-start position when the rotor stops rotating.

2. Description of the Related Art

Fig. 9 of the drawings, which corresponds to Fig. 2b of U.S. Patent No. 4,899,075 to Hasebe issued on Feb. 6, 1990, illustrates a conventional stator structure of a bi-directional brushless DC motor comprising a pair of stator cores each having a plurality of salient poles 9a~9d each of which is shaped to have a notched portion 92 in one of opposite corners, in a direction of rotation of the rotor, and oriented so as to be next to the unnotched corner of the stator pole adjacent thereto.

Fig. 10 of the drawings illustrates another conventional stator structure of a DC brushless motor structure disclosed in Taiwan Utility Model Application No. 81217854 published on Nov. 1, 1993 and entitled "IMPROVED STATOR YOKE FOR A STATOR OF A HEAT-DISSIPATING FAN MOTOR". Each of an upper stator yoke 8 and a lower stator yoke 8 comprises plural poles 81 on a peripheral edge thereof, each pole 81 having a notched portion 82 in a side thereof.

The notched portions 92 and 82 in these conventional DC brushless motor structures are designed to create an uneven magnetic force associated with the permanent magnet, thereby preventing the rotor to stop in a dead corner for starting and thereby allowing the rotor to be restarted.

Summary of the Invention

An object of the present invention is to provide an easy-to-start structure of a DC brushless motor that prevents the rotor of the motor to stop in a dead corner for starting and that allows the rotor to be restarted easily.

An easy-to-start structure for a DC brushless motor in accordance with the present invention comprises a base including a through-hole having an end in which a support section is provided. Plural windings and an IC control member are mounted to the base, the IC control member being located between two windings that are adjacent to each other. At least one magnetically attractive positioning member is mounted to the base and located between two windings that are adjacent to each other. A rotor comprises a shaft rotatably held by the support section and a permanent magnetic ring mounted to the shaft, the permanent magnetic ring having north and south poles, each of the south pole and the north pole having a strong magnetic area. The positioning member attracts and thus retains one of the strong magnetic areas of the permanent magnetic ring in a position proximal to the positioning member when the rotor stops. Thus, the rotor rests in a pre-determined position not located in a dead corner for restarting.

Other objects, specific advantages, and novel features of the invention will become more apparent from the following detailed description and preferable embodiments when taken in conjunction with the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is an exploded perspective view of a first embodiment of a DC brushless motor structure in accordance with the present invention.

Fig. 2 is a sectional view of the DC brushless motor structure in Fig. 1.

Fig. 3 is an exploded perspective view of a second embodiment of the DC brushless motor structure in accordance with the present invention.

Fig. 4 is a sectional view of the DC brushless motor structure in Fig. 3.

Fig. 5 is a sectional view taken along line 5-5 in Fig. 4.

Fig. 6 is an exploded perspective view of a third embodiment of the DC brushless motor structure in accordance with the present invention.

Fig. 7 is a sectional view of the DC brushless motor structure in Fig. 6.

Fig. 8 is a sectional view taken along line 8-8 in Fig. 7.

Fig. 9 is a plan view of a stator core of a conventional DC brushless motor structure disclosed in U.S. Patent No. 4,899,075.

Fig. 10 is a perspective view of another conventional DC brushless motor structure disclosed in Taiwan Utility Model Application No. 81217854.

Detailed Description of the Preferred Embodiments

Preferred embodiments in accordance with the present invention will now be described with reference to the accompanying drawings.

Referring to Fig. 1, a first embodiment of a DC brushless motor structure in accordance with the present invention generally comprises a base 1 and a rotor 2.

The base 1 is a casing having a through-hole 11. A support section 12 is provided in an end of the through-hole 11. The support section 12 may be a bearing or shaft sleeve for rotatably holding a shaft 21 of the rotor 2.

1 Even-numbered windings 13 are securely mounted to an outer wall of the
2 base 1 or an inner wall defining the through-hole 11. An IC control means
3 14 comprising a conventional drive circuit and a Hall element is mounted
4 on the base 1. The IC control means 14 is located between two adjacent
5 windings 13 and electrically connected to the windings 13. In order to
6 allow stable rotation of the rotor 2, a support element 15 is mounted on the
7 other end of the base 1. The support element 15 may be directly fixed on
8 the base 1. As shown in Fig. 1, the support element 15 comprises engaging
9 pieces 151 that are respectively engaged in positioning holes 16 in the base
10 1. The support element 15 comprises a support section 152 in the form of a
11 bearing or shaft sleeve. Of more importance, at least one positioning
12 member 17 made of magnetically attractive metal is mounted to the base 1.
13 The positioning member 17 can be of any shape, such as a cylinder,
14 parallelepiped, or plate. As illustrated in Fig. 1, the positioning member 17
15 is positioned in a complementary positioning hole or groove 18 in the base
16 1, the positioning groove 18 being located between two windings 13.

17 The shaft 21 of the rotor 2 is rotatably held by the support section 12
18 of the base 1 and the support section 152 of the support element 15. A
19 permanent magnetic ring 22 is mounted to the shaft 21 of the rotor 2 and
20 comprises north and south poles. The permanent magnetic ring 22
21 comprises at least two transition areas 221, each transition area 221 having
22 a first end contiguous to a north pole and a second end contiguous to a
23 south pole. Each of the north and south poles has a strong magnetic area
24 222 located in an intermediate position between two transition areas 221. In
25 addition, the rotor 2 may have blades 23 provided thereon so as to drive air
26 to flow when the rotor 2 turns, thereby forming a heat-dissipating fan.

1 As illustrated in Fig. 2, the base 1 has even-numbered windings 13
2 mounted to the outer wall thereof. The rotor 2 is received in the through-
3 hole 11 of the base 1. Two ends of the shaft 21 of the rotor 2 are
4 respectively, rotatably received in the support section 12 of the base 1 and
5 the support section 152 of the support element 15. And the permanent
6 magnetic ring 22 of the rotor 2 is located in a position relative to the
7 windings 13 on the base 1. The IC control means 14 detects a change in the
8 polarities of the permanent magnetic ring 22 of the rotor 2 and sends a
9 signal to alter the polarities of the magnetic fields created by the windings
10 13, thereby driving the permanent magnetic ring 22 to turn by repulsive
11 forces. When the rotor 2 stops, one of the strong magnetic areas 222 of the
12 north and south poles of the permanent magnetic ring 22 is attracted and
13 thus retained in place by the magnetically attractive positioning member 17
14 on the base 1. Thus, the strong magnetic area 222 of each magnetic pole of
15 the permanent magnetic ring 22 is located away from a respective winding
16 13 on the base 1. Namely, the transition areas 221 of the permanent
17 magnetic ring 22 are not proximal to and thus not face the IC control means
18 14. As a result, when the rotor 2 is to be restarted, the IC control means 14
19 will surely be able to detect the polarities of the permanent magnetic ring
20 22 and thus reliably restart the motor easily.

21 Fig. 3 illustrates a second embodiment of the invention comprising a
22 base 3 and a rotor 4.

23 The base 3 is a casing having a through-hole 31. A support section
24 32 is provided in an end of the through-hole 31. The support section 32
25 may be a bearing or shaft sleeve for rotatably holding a shaft 41 of the rotor
26 4. Even-numbered windings 33 are securely mounted to an outer wall of the

1 base 3 or an inner wall defining the through-hole 31. An IC control means
2 34 comprising a conventional drive circuit and a Hall element is mounted
3 on the base 3. The IC control means 34 is located between two adjacent
4 windings 33 and electrically connected to the windings 33. In order to
5 allow stable rotation of the rotor 4, a support element 35 is mounted on the
6 other end of the base 3 and has a support section 351 in the form of a
7 bearing or shaft sleeve. Of more importance, at least one positioning
8 member 36 made of magnetically attractive metal is mounted to the base 3.
9 The positioning member 36 can be of any shape, such as a disc, cube, or
10 plate. The positioning member 36 is positioned between two windings 33.

11 The shaft 41 of the rotor 4 is rotatably held by the support section 32
12 of the base 3 and the support section 351 of the support element 35. A
13 permanent magnetic ring 42 is mounted to the shaft 41 of the rotor 4 and
14 comprises north and south poles. If necessary, a washer 43 made of
15 abrasion-resistant material may be mounted around the shaft 41 and located
16 between the permanent magnetic ring 42 and the support section 32 of the
17 base 3, and another washer 43 made of abrasion-resistant material may be
18 mounted around the shaft 41 and located between the permanent magnetic
19 ring 42 and the support section 351 of the support element 35. The
20 permanent magnetic ring 42 comprises at least two transition areas 421,
21 each transition area 421 having a first end contiguous to a north pole and a
22 second end contiguous to a south pole. Each of the north and south poles
23 has a strong magnetic area 422 located in an intermediate position between
24 two transition areas 421.

25 As illustrated in Figs. 4 and 5, the base 3 has even-numbered
26 windings 33 mounted to the outer wall thereof. The rotor 4 is received in

1 the through-hole 31 of the base 3. Two ends of the shaft 41 of the rotor 4
2 are respectively, rotatably received in the support section 32 of the base 3
3 and the support section 351 of the support element 35. And the permanent
4 magnetic ring 42 of the rotor 4 is located in a position relative to the
5 windings 33 of the base 3. The IC control means 34 detects a change in the
6 polarities of the permanent magnetic ring 42 of the rotor 4 and sends a
7 signal to alter the polarities of the magnetic fields created by the windings
8 33, thereby driving the permanent magnetic ring 42 to turn by repulsive
9 forces. When the rotor 4 stops, one of the strong magnetic areas 422 of the
10 north and south poles of the permanent magnetic ring 42 is attracted and
11 thus retained in place by the magnetically attractive positioning member 36
12 on the base 3. Thus, the strong magnetic area 422 of each magnetic pole of
13 the permanent magnetic ring 42 is located away from a respective winding
14 33 on the base 3. Namely, the transition areas 421 of the permanent
15 magnetic ring 42 are not proximal to and thus not face the IC control means
16 34. As a result, when the rotor 4 is to be restarted, the IC control means 34
17 will surely be able to detect the polarities of the permanent magnetic ring
18 42 and thus reliably restart the motor easily.

19 Fig. 6 illustrates a third embodiment of the invention comprising a
20 base 5 and a rotor 4.

21 The base 5 is a casing having a through-hole 51. A support section
22 52 is provided in an end of the through-hole 51. The support section 52
23 may be a bearing or shaft sleeve for rotatably holding a shaft 41 of the rotor
24 4. Even-numbered windings 53 are securely mounted to an outer wall of the
25 base 5 or an inner wall defining the through-hole 51. An IC control means
26 54 comprising a conventional drive circuit and a Hall element is mounted

1 on the base 5. The IC control means 54 is located between two adjacent
2 windings 53 on the base 5 and electrically connected to the windings 53. In
3 order to allow stable rotation of the rotor 4, at least one rib 57 is formed on
4 the outer wall of the base 5 to prevent damage to the windings 53 or the IC
5 control means 54 when a casing 56 is tightly fitted around the base 5. The
6 casing 56 mounted around the base 5 has an end beyond the base 5, and a
7 support element 55 is mounted to the end of the casing 56. The support
8 element 55 has a support section 551 in the form of a bearing or shaft
9 sleeve. At least one positioning member 561 made of magnetically
10 attractive metal is provided on the casing 56 and can be of any shape, such
11 as a disc, cube, or plate. The positioning member 561 is positioned between
12 two windings 53. In a preferred embodiment, the casing 56 is made of
13 magnetically attractive metal, and the positioning member 561 is directly
14 formed on an inner periphery of the casing 56 by means of pressing. Thus,
15 the positioning element 561 is more proximal to the permanent magnetic
16 ring 42 of the rotor 4 than the inner periphery of the casing 56 is.

17 The shaft 41 of the rotor 4 is rotatably held by the support section 52
18 of the base 5 and the support section 551 of the support element 55. The
19 permanent magnetic ring 42 is mounted to the shaft 41 of the rotor 4 and
20 comprises north and south poles. The permanent magnetic ring 42
21 comprises at least two transition areas 421, each transition area 421 having
22 a first end contiguous to a north pole and a second end contiguous to a
23 south pole. Each of the north and south poles has a strong magnetic area
24 422 located in an intermediate position between two transition areas 421.

25 As illustrated in Figs. 7 and 8, the base 5 has even-numbered
26 windings 53 mounted to the outer wall thereof. The rotor 4 is received in

1 the through-hole 51 of the base 5. Two ends of the shaft 41 of the rotor 4
2 are respectively, rotatably received in the support section 52 of the base 5
3 and the support section 551 of the support element 55. And the permanent
4 magnetic ring 42 of the rotor 4 is located in a position relative to the
5 windings 53 of the base 5. The IC control means 54 detects a change in the
6 polarities of the permanent magnetic ring 42 of the rotor 4 and sends a
7 signal to alter the polarities of the magnetic fields created by the windings
8 53, thereby driving the permanent magnetic ring 42 to turn by repulsive
9 forces. When the rotor 4 stops, one of the strong magnetic areas 422 of the
10 north and south poles of the permanent magnetic ring 42 is attracted and
11 thus retained in place by the magnetically attractive positioning member
12 561 on the casing 56. Thus, the strong magnetic area 422 of each magnetic
13 pole of the permanent magnetic ring 42 is located away from a respective
14 winding 53 on the base 5. Namely, the transition areas 421 of the
15 permanent magnetic ring 42 are not proximal to and thus not face the IC
16 control means 54. As a result, when the rotor 4 is to be restarted, the IC
17 control means 54 will surely be able to detect the polarities of the
18 permanent magnetic ring 42 and thus reliably restart the motor easily.

19 The easy-to-start DC brushless motor structure in accordance with
20 the present invention provides a magnetically attractive positioning
21 member between any two of the windings as well as an IC control means
22 that is capable of detecting the polarities of the permanent magnetic ring of
23 the rotor, such that when the rotor stops, one of the strong magnetic areas of
24 the permanent magnetic ring of the rotor is attracted by the magnetically
25 attractive positioning member and thus retained in a place not facing the IC
26 control means. Thus, it is impossible for the transition areas of the

1 permanent magnetic ring to be located in a position proximal to the IC
2 control means. As a result, when restarting is required, the IC control
3 means will always be capable of detecting the polarities of the permanent
4 magnetic ring of the rotor and thus allow the rotor to be restarted easily.

5 Although the invention has been explained in relation to its preferred
6 embodiment as mentioned above, it is to be understood that many other
7 possible modifications and variations can be made without departing from
8 the scope of the invention. It is, therefore, contemplated that the appended
9 claims will cover such modifications and variations that fall within the true
10 scope of the invention.

1 **What is claimed is:**

- 2 1. An easy-to-start structure for a DC brushless motor, comprising:
- 3 a base comprising a through-hole having an end, a support
- 4 section being provided in the end of the through-hole, plural windings
- 5 and an IC control means being mounted to the base, at least one
- 6 positioning member being mounted to the base and located between
- 7 said plural windings; and
- 8 a rotor comprising a shaft and a permanent magnetic ring
- 9 having a north pole and a south pole, each of the south pole and the
- 10 north pole having a strong magnetic area, the shaft being rotatably
- 11 held by the support section;
- 12 said at least one positioning member being made of a material
- 13 capable of magnetically attracting and thus retaining one of the strong
- 14 magnetic areas of the permanent magnetic ring in a position proximal
- 15 to said at least one positioning member when the rotor stops.
- 16 2. The easy-to-start structure for a DC brush less motor as claimed in
- 17 claim 1, further comprising a support element mounted to another end
- 18 of the through-hole, the support element comprising a second support
- 19 section for rotatably holding an end of the shaft of the rotor.
- 20 3. The easy-to-start structure for a DC brushless motor as claimed in
- 21 claim 1, wherein the base has at least one positioning groove for
- 22 receiving said at least one positioning member.
- 23 4. The easy-to-start structure for a DC brushless motor as claimed in
- 24 claim 1, wherein the IC control means is located between two of said
- 25 plural windings that are adjacent to each other.

- 1 5. The easy-to-start structure for a DC brushless motor as claimed in
2 claim 1, wherein the rotor has blades mounted thereon.
- 3 6. The easy-to-start structure for a DC brushless motor as claimed in
4 claim 2, wherein the base comprises at least one engaging hole, and
5 wherein the support element comprises at least one engaging piece for
6 engaging with said at least one engaging hole.
- 7 7. An easy-to-start structure for a DC brushless motor, comprising:
8 a base comprising a through-hole having an end, a support
9 section being provided in the end of the through-hole, plural windings
10 and an IC control means being mounted to the base;
11 a rotor comprising a shaft and a permanent magnetic ring
12 having a north pole and a south pole, each of the south pole and the
13 north pole having a strong magnetic area, the shaft being rotatably
14 held by the support section; and
15 a casing mounted around the base, the casing comprising at
16 least one positioning member provided thereon, said at least one
17 positioning member being located between said plural windings;
18 said at least one positioning member being made of a material
19 capable of magnetically attracting and thus retaining one of the strong
20 magnetic areas of the permanent magnetic ring in a position proximal
21 to said at least one positioning member when the rotor stops.
- 22 8. The easy-to-start structure for a DC brushless motor as claimed in
23 claim 7, wherein the base further comprises at least one rib on an
24 outer wall thereof, and wherein the casing is tightly fitted to said at
25 least one rib.

- 1 9. The easy-to-start structure for a DC brushless motor as claimed in
2 claim 7, wherein said at least one positioning member being directly
3 formed on the casing by means of pressing.
- 4 10. The easy-to-start structure for a DC brushless motor as claimed in
5 claim 7, further comprising a support element mounted to another end
6 of the through-hole, the support element comprising a second support
7 section for rotatably holding an end of the shaft of the rotor.
- 8 11. The easy-to-start structure for a DC brushless motor as claimed in
9 claim 7, wherein the IC control means is located between two of said
10 plural windings that are adjacent to each other.



Application No: GB 0122524.2
Claims searched: 1 - 11

Examiner: Bill Riggs
Date of search: 4 April 2002

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): H2A (ARJ9B, ARR1)

Int Cl (Ed.7): H02K 29/03, H02K+

Other: Online databases: EPODOC, JAPIO, OPTICS: H2A, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	US 4757222 A (Shicoh) see particularly fig. 12	1, 7 at least
X	US 4728833 A (Shicoh) see particularly figs 6 and 9	1, 7 at least
X	PAJ abstract and JP 62147941 (Matsushita) see abstract and figs.	1, 7 at least
X	PAJ abstract and JP 60113646 (Takahashi) see abstract and fig.4	1, 7 at least
X	PAJ abstract and JP 2214455 (Shicoh) see abstract and figs.	1, 7 at least

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X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.